DRAFT FINAL REPORT

Lake Champlain Nonpoint Source Pollution Assessment

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Principal Investigators

Lenore F. Budd

Associates in Rural Development, Inc.
110 Main Street, Fourth Floor
P.O. Box 1397
Burlington, VT 05402
802-658-3890

Donald W. Meals

UVM School of Natural Resources
Aiken Center
Burlington, VT 05405
802-656-4057

In the 1973-76 era, the LCB was composed of 62% forested land, 28% agricultural, 3% urban and 7% water. Forested land comprised the bulk of the basin in New York and the uplands in Vermont. Agricultural uses were concentrated in relatively flat areas near the lake, primarily in Vermont. Urban uses were concentrated around Burlington in Vermont and Plattsburgh in New York. The land use composition of individual HUs is detailed in tables in Section 6.4.

6.2 Nonpoint Source Loading Coefficients.

More than 250 references were reviewed during the literature search for appropriate nonpoint source loading coefficients for the LCB. Following the screening criteria described in Section 5.1, about 180 references were included in a data base of pollutant export coefficient and loading function concentration values for land uses ranging from 100% forested land to urban central business districts.

Values were sought for major nonpoint source pollutants, including suspended solids (TSS), total phosphorus (TP), soluble reactive phosphorus (SRP), total nitrogen (TN), nitrate nitrogen (NO_3-N), ammonia nitrogen (NH_3-N), and bacteria. The nonpoint source literature for the past two decades has clearly emphasized phosphorus and nitrogen. Despite the importance of bacteria as a nonpoint source pollutant, very little relevant data concerning bacteria have been reported that met the screening criteria for this study and those values that were found show tremendous variability. The data base was also very scant for suspended solids and for nitrate and ammonia nitrogen. The relatively few coefficient values that were obtained for TSS, NO_3-N, and NH_3-N are cataloged and reported, but no loading estimates were made for these pollutants. This study will address only those pollutants for which there appears to be an adequate data base from which to make reasonable selections: total phosphorus, soluble phosphorus, and total nitrogen.

Values for both export coefficients and loading function concentrations were cataloged by both general and specific land use category. All of the coefficients thus obtained are organized in six tables (Appendix B), representing areal export or concentration values for each of the general land use categories in the LCB used for Phase I of this study: Forest, Agriculture, and Urban. Within the agriculture and urban tables, values are listed first that were reported for the general category (e.g. "mixed agriculture" or "mostly urban"), then by more specific land use (e.g. row crops, pasture, residential, commercial). These values were used in Phase II of this study. Some studies reported mean or median values for either concentration or export, while other studies reported a range of values; both types are included in the tables. Other information listed in the tabulation of coefficients includes location, type (e.g. monitoring, literature review), citation, and notes concerning any special circumstances.

The process for selecting appropriate values to be applied in the LCB was outlined in Section 5.2. Because of the inherent variability and uncertainty of nonpoint source processes, no simple average or single value could easily be selected from this data base. First, the most commonly reported range for each pollutant and each land use was identified, representing approximately the 25th and 75th percentile of the range of reported values. Within this range, a single baseline value was chosen, representing the best judgement of an appropriate value to be applied in the LCB.

The range of values chosen for TP and TN from general land use categories is shown graphically in Figures 6.3 through 6.6. In these figures, the overall range in reported coefficients is represented by the entire bar, with the most commonly reported range shaded. Note that the horizontal scale is logarithmic due to the extreme range of reported values. Total N concentrations reported from urban land, for example, ranged from 0.3 to 75.0 mg/l.

The lowest concentrations and export coefficients for both P and N tend to be reported for forest land. While there is some overlap, phosphorus values reported for urban land tend to be higher than those for agricultural land. The reverse is true for reported nitrogen levels, possibly due to high fertilizer N inputs on agricultural land.

The baseline values selected for this study are indicated in Figures 6.3 - 6.6 by the stars. The values representing the low end of the most common range, the baseline values, and the values at the high end of the most common range will be used as low, baseline, and high coefficient values, respectively. These values for TP, SRP, and TN from general land use categories are presented in Tables 6.3 and 6.4. Estimated nonpoint source loads were calculated subsequently based on this range of literature values.

6.3 Hydrology.

6.3.1 Precipitation. Annual total precipitation values from 1951 through 1992 for each of the 47 stations applicable to the LCB are tabulated in Appendix C, along with summary statistics including years of record, minimum and maximum annual precipitation, standard deviation, and ± 95% confidence limits. A few stations had virtually complete record, such as Burlington and Montpelier, VT and Dannemora and Glens Falls, NY. Other stations, e.g. Essex Junction, VT and Ray Brook, NY, had large gaps and included as few as 17 years of record. The lowest average annual precipitation (740 mm, 29.12 inches) occurred at Peru, NY (Station #6538); the highest average annual precipitation of 1588 mm (62.51 inches) occurred at Mt. Mansfield, VT (Station #5416).

The Thiessen polygons developed in ARC/INFO for the array of precipitation stations covering the LCB is shown in Figure 6.7. Area weighting factors used in calculating precipitation for each HU were derived from overlaying the polygon coverage with the HU boundary coverage, as shown in the example for HU -7050 in Figure 6.8. Annual area-weighted precipitation totals for each year of complete record for each 11-digit HU (see discussion of missing data in Section 5.3.1) are tabulated in Appendix D. For each HU, similar summary statistics are also shown, including mean and ± 95% confidence limits. The lowest area-weighted mean annual precipitation (741 mm, 29.17 inches) occurred in a HU within the lower Ausable River, NY. The highest area-weighted mean annual precipitation of 1282 mm (50.46 inches) occurred in a HU in the lower Lamoille River, VT.

Values for the lower 95% confidence limit, the mean, and the upper 95% confidence limit will be used as low, average, and high HU precipitation, respectively. These values are summarized in Table 6.6 below.
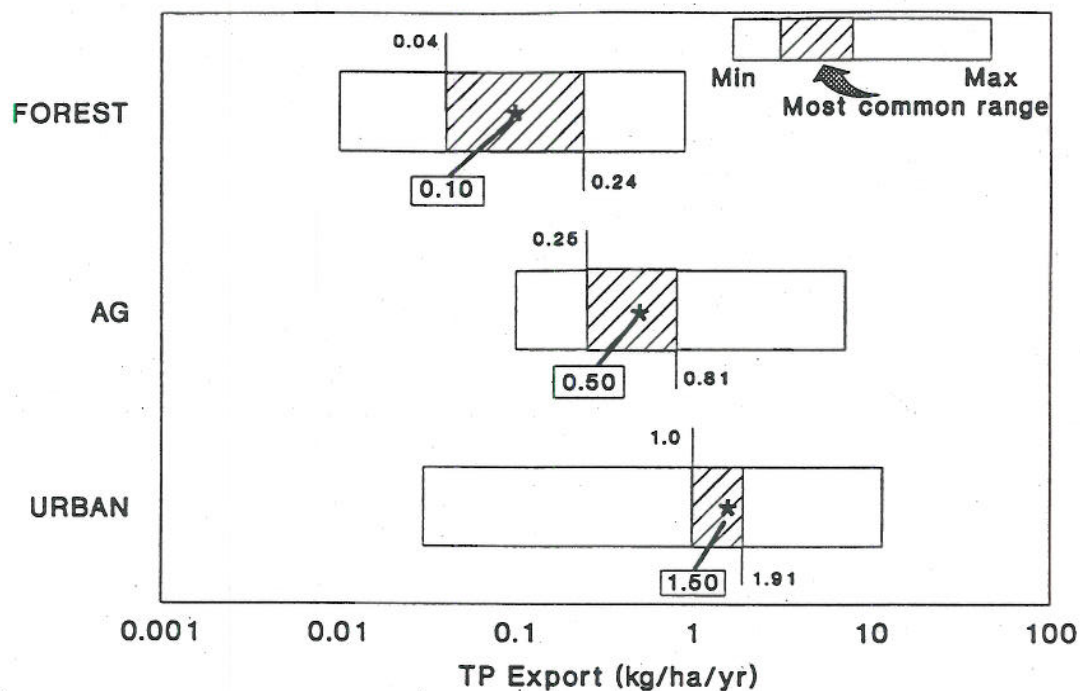
FIGURE 6.3

RANGE IN TOTAL P EXPORT
(kg/ha/yr)

FOREST — 0.04, 0.10, 0.24

Min — Max — Most common range

AG — 0.25, 0.50, 0.81

URBAN — 1.0, 1.50, 1.91

TP Export (kg/ha/yr)

0.001   0.01   0.1   1   10   100

FIGURE 6.4

RANGE IN TOTAL N EXPORT
(kg/ha/yr)

FOREST — 2.0, 3.5, 5.5

AG — 4.8, 7.0, 14.0

URBAN — Min — Max — Most common range — 6.1, 8.5, 10.2

TN Export (kg/ha/yr)

0.01   0.1   1   10   100
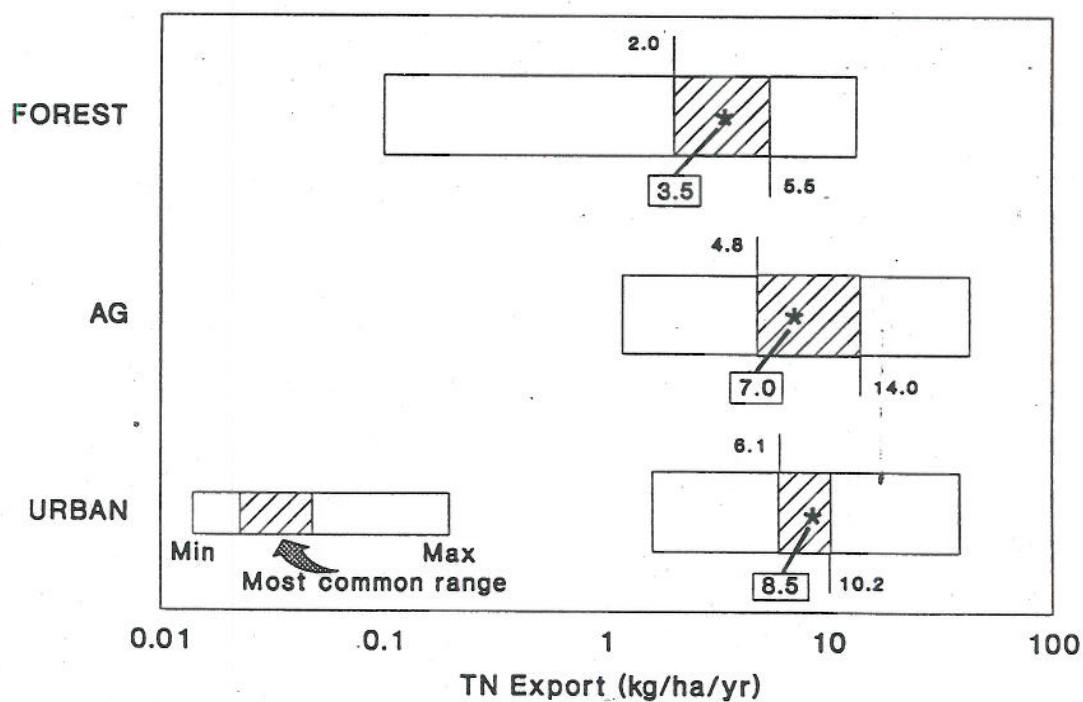
FIGURE 6.5

RANGE IN TOTAL P CONCENTRATION
(mg/l)

Min — Most common range — Max

FOREST
0.01
0.015 0.025

AG
0.10
0.20 0.30

URBAN
0.28
0.35 0.82

0.001   0.01   0.1   1   10

TP Concentration (mg/l)

FIGURE 6.6

RANGE IN TOTAL N CONCENTRATION
(mg/l)

Min — Most common range — Max

FOREST
0.5
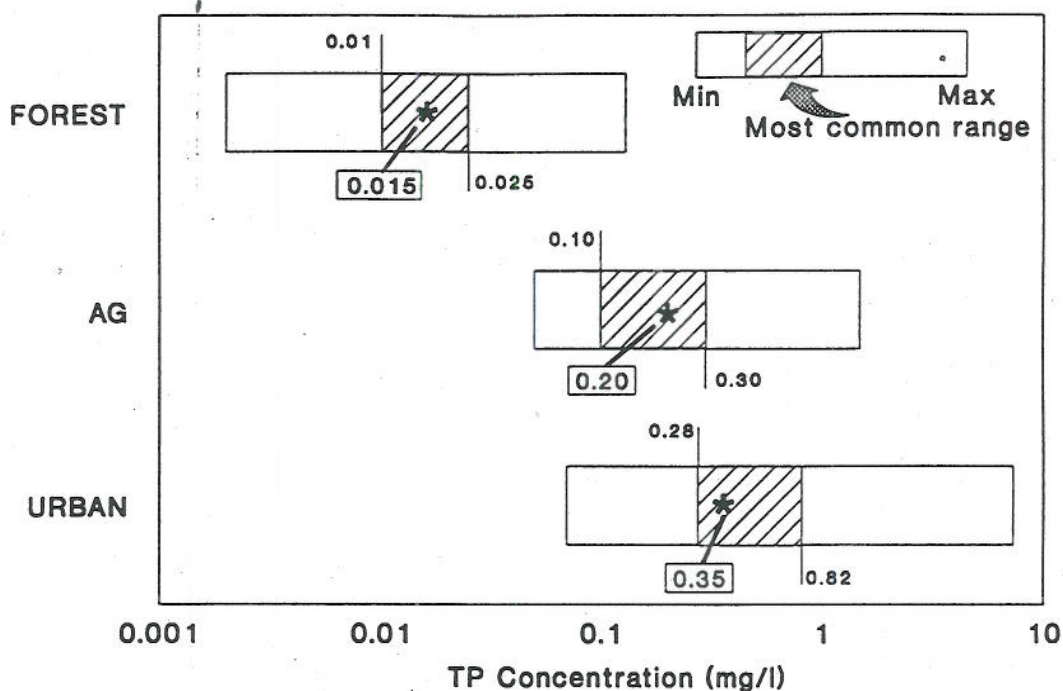0.80 1.0

AG
2.0
2.5 3.4

URBAN
1.8
2.5 3.31

0.1   1   10   100

TN Concentration (mg/l)
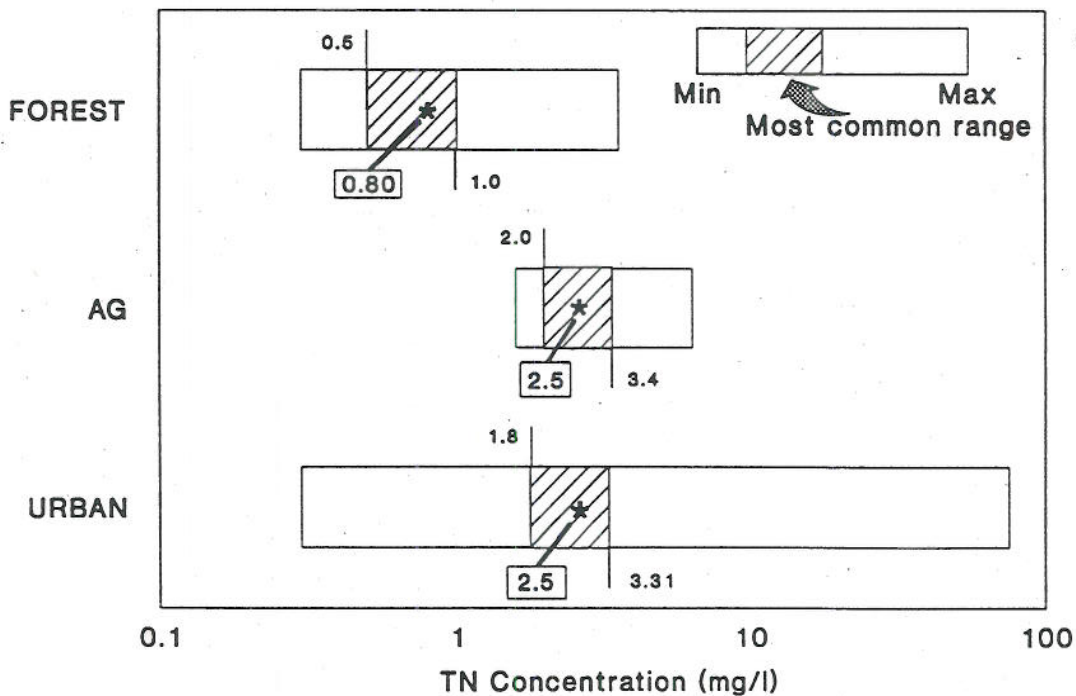
TABLE 6.5

LITERATURE EXPORT VALUES
(kg/ha/yr)

FORESTED LAND

PARAMETER	TOTAL RANGE	MOST FREQUENTLY REPORTED	SELECTED
TP	0.01-0.90	0.04-0.24	0.10
SRP	0.007-0.170	0.03-0.07	0.05
TN	0.10-13.45	2.0-5.5	3.5

AGRICULTURAL LAND

PARAMETER	TOTAL RANGE	MOST FREQUENTLY REPORTED	SELECTED
TP	0.10-7.17	0.25-0.81	0.50
SRP	0.09-4.48	0.09-0.22	0.15
TN	1.2-42.6	4.8-14.0	7.0

URBAN LAND

PARAMETER	TOTAL RANGE	MOST FREQUENTLY REPORTED	SELECTED
TP	0.03-11.6	1.00-1.91	1.50
SRP	0.03-2.00	0.21-1.00	0.50
TN	1.6-38.5	6.1-10.2	8.5

TABLE 6.4

LITERATURE CONCENTRATION VALUES
(mg/l)

FORESTED LAND

PARAMETER	TOTAL RANGE	MOST FREQUENTLY REPORTED	SELECTED
TP	0.002-0.130	0.01-0.025	0.015
SRP	0.001-0.023	---	0.007
TN	0.30-3.60	0.5-1.0	0.80

AGRICULTURAL LAND

PARAMETER	TOTAL RANGE	MOST FREQUENTLY REPORTED	SELECTED
TP	0.05-1.50	0.10-0.30	0.20
SRP	0.01-0.61	0.05-0.7	0.06
TN	1.6-6.4	2.0-3.4	2.5

URBAN LAND

PARAMETER	TOTAL RANGE	MOST FREQUENTLY REPORTED	SELECTED
TP	0.07-7.3	0.28-0.82	0.35
SRP	0.04-10.0	0.12-0.32	0.20
TN	0.3-75.	1.80-3.31	2.5